CLAIMS

1. A method for sensing the contour of a surface of an object, comprising the steps of:

providing a plurality of surface sensing pins;

mounting said pins on a support with their free ends disposed in a sensing plane and biased against axial movement from their extended positions;

providing relative movement between the ends of the pins and the surface of the object;

causing the ends of the pins to approach and press against the surface of the object;

detecting when the end of each sensing pin contacts said surface and storing a point contact contour value for the pin indicating the amount of movement required to achieve the contact; and

allowing each pin to independently move axially against said bias force as the surface continues to press against the pin.

2. The method of Claim 1, further including the steps of:
providing a human foot as an object; and
pressing a surface of the foot against the ends of said pins.

3. The method of Claim 1, further including the steps of:
providing a human foot as an object; and
pressing the bottom surface of the foot against the ends of said pins.

4. The method of Claim 1, further including the steps of:

providing a human foot as an object;

providing a movable support plate disposed at a rest position above said sensing plane and having holes aligned with the ends of said pins; and

pressing the bottom surface of the foot against the support plate and downward so that the ends of the pins engage and press against the bottom surface of the foot through said holes.

5. The method of Claim 4, further including the step of resiliently biasing the support plate against downward movement toward the ends of the pins.

6. The method of Claim 4, wherein said step of detecting includes the step of measuring the displacement of said support plate from a predefined zero reference position to indicate the amount of movement required to achieve the contact.

7. The method of Claim 6, further including the step of defining the sensing plane as the zero reference position of the support plate.

8. The method of Claim 4, wherein said step of detecting further includes the steps of:

generating an electrical signal for each decremental movement of the support plate from the sensing plane and toward the support for the pins;

counting each such signal; and

storing the count as a point contour value for each pin when the pin contacts the surface of the object.

9. The method of claim 8, further including the steps of:

providing a plurality of actuating pins diminishing in size; and

successively actuating these pins and generating said electrical signals in response to movement of the support plate toward the support for the pins.

10. The method of Claim 4, further including the step of using coil springs to bias said pins in extended vertical orientation to said support.

11. The method of Claim 4, further including the step of using resilient foam to bias said pins in extended vertical orientation to said support.

12. The method of Claim 4, further including the step of orienting the ends of the sensing pins downward and using the force of gravity to bias the pins to their fully extended position.

13. The method of Claim 4, wherein said step of detecting further includes the step of measuring the distance between the support for the pins and the support plate to indicate the amount of movement required to achieve the contact.

14. The method of Claim 4, wherein said step of detecting includes the step of activating a switch associated with each pin when the end of the pin initially contacts said surface and is moved axially.

15. The method of Claim 4, wherein said step of detecting includes the steps of:

providing an electrically conducting cover for the contact surface of said foot;

providing electrically conductive sensing pins;

energizing the pins;

grounding the cover; and

sensing an electrical signal that occurs when each energized pin contacts the cover.

16. The method of Claim 1, wherein said step of detecting includes the step of activating a switch associated with each pin when the end of the pin initially contacts said surface and is moved axially.

17. The method of Claim 1, wherein said step of detecting includes the steps of:

providing an electrically conducting cover for the contact surface of said object;

providing electrically conductive sensing pins;

energizing the pins;

grounding the cover; and

sensing an electrical signal that occurs when each energized pin contacts the cover.

18. The method of Claim 1, wherein said step of detecting further includes the steps of:

generating an electrical signal for each relative decremental movement between the surface of the object and the support for the pins;

counting each such signal; and

storing the count as a point contour value for each pin when the pin contacts the surface of the object.

19. The method of Claim 18, further including the steps of:

providing a plurality of actuating pins diminishing in size; and

successively actuating these pins and generating said electrical signals in response to the relative decremental movement of the surface of the object and the support of the pins.

20. The method of Claim 1, further including the steps of:

providing a stationary support plate supporting the surface of the object above the sensing pins and having holes aligned with the ends of the pins; and

moving said pin support upward toward said support plate so that the ends of the pins engage and press against the surface of the object through said holes.

21. The method of Claim 20, wherein said step of detecting further includes the step of measuring the displacement of the pin support from a predefined zero reference position to indicate the amount of movement required to achieve the contact.

22. The method of Claim 1, further including the step of displaying the point contact contour values of the pins to provide an image of said object.

23. The method of Claim 1, further including the steps of:

using the human foot as an object; and

displaying the point contact contour values of the pins to provide an image of the contour of the foot.

24. The method of Claim 1, further including the steps of:

using the human foot as an object; and

analyzing said point contact contour values of the pins to determine the physical dimensions of the foot.

25. The method of Claim 1, further including the steps of:

using the human foot as an object; and

analyzing said point contact contour values of the pins to select at least one shoe that will fit the foot.

26. The method of Claim 1, further including the steps of:

using the human foot as an object; and

applying said point contact contour values of the pins to manufacture an insole contoured to fit and support the foot.

27. The method of Claim 1, further including the steps of:

using a human foot as an object; and

applying said point contact contour values of the pins to manufacture a shoe to fit and support the foot.

28. A method for sensing the contour of a surface of an object, comprising the steps of:

providing a plurality of upstanding sensing pins biased against axial movement;

engaging the ends of the pins with a surface of the object; and

storing a value to indicate a relative displacement for the end of each pin as the pin contacts a point on the surface of the object.

29. A method for sensing the contour of a surface of the human foot, comprising the steps of:

providing a plurality of upstanding sensing pins biased against axial movement;

engaging the ends of the pins with a surface of the foot; and

storing a value to indicate a relative displacement for the end of each pin as the pin contacts a point on the surface of the foot.

30. The method of Claim 29, further including the step of using the stored displacement values to determine the size and contour of the surface of the foot.

31. The method of Claim 29, further including the step of using the stored displacement values to select one or more shoes that will fit the foot.

32. The method of Claim 29, further including the step of using the stored displacement values to manufacture an insole shaped to the contour of the underside of the foot.

33. The method of Claim 29, further including the step of using the stored displacement values to manufacture a shoe shaped to the contour of the foot.

34. The method of Claim 29, further including the step of obtaining stored displacement values for the underside of the foot and the instep of the foot and using this information to define the shape of the top and bottom of the foot.

35. A contour sensing apparatus, comprising:

a base for holding a plurality of upstanding sensing pins biased against axial movement;

means for providing relative movement between a surface of an object and the ends of said pins so that the ends of the pins engage points on said surface as the surface presses against the pins;

means for counting predefined decrements of movement as the distance between the surface and pins decreases; and

means for storing the value of the count for each pin at the time the pin contacts the surface of the object, the counts for said pins defining the sensed contour of the surface.

36. The sensing apparatus of Claim 35, further including means for setting a maximum count value for all pins that do not contact the surface of the object.

37. The sensing apparatus of Claim 35, wherein said means for counting includes a counter.

38. The sensing apparatus of Claim 35, wherein said means for counting includes a microcontroller.

39. The sensing apparatus of Claim 35, wherein said means for storing includes a random access memory.

40. The sensing apparatus of Claim 35, wherein said base includes a coil spring for biasing each sensing pin against axial movement away from the surface of the object.

41. The sensing apparatus of Claim 35, wherein said base includes resilient foam for biasing each sensing pin against axial movement away from the surface of the object.

42. The sensing apparatus of Claim 35, wherein said pins are biased against axial movement by the force of gravity.

43. The sensing apparatus of Claim 35, wherein said means for providing relative movement is a plate for engaging the object, the plate having holes aligned with the ends of said pins so that the ends of the pins pass through the holes and engage the surface of the object adjacent to the plate as the surface and plate move toward the pins.

44. The sensing apparatus of Claim 43, including means for resiliently biasing said plate against movement toward the ends of said pins.

45. The sensing apparatus of Clam 35, wherein said object is the human foot.

46. A foot contour sensing apparatus comprising:

a base for holding an array of upstanding sensing pins biased against axial movement;

a plate disposed above the ends of said pins for supporting a human foot, the plate having holes aligned with the ends of said sensing pins and being resiliently biased against axial movement toward the pins;

means for counting predefined decrements of movement as the foot presses the plate downward toward the pins, the pins passing through the holes in the plate and engaging the undersurface of the foot as the plate is pressed down; and

means for storing the value of the count for each pin at the time the pin contacts the undersurface of the foot, the stored counts for the pins defining the sensed contour of the undersurface of the foot.

47. The contour sensing apparatus of Claim 46, wherein each of said pins includes switching means for generating an electrical signal that indicates the initial contact of the end of the pin with the undersurface of the foot.

48. The contour sensing apparatus of Claim 47, wherein said switching means includes a switch that generates a first electrical signal when the pin is in its upright position out of contact with the surface of the foot and a second electrical signal when the pin is moved axially by pressing contact with the surface of the foot, said second signal indicating contact of the pin and foot.

49. The contour sensing apparatus of Claim 47, wherein said switching means includes a grounded electrically conducting cover for the undersurface of the foot and an electrically conducting energized pin, the pin generating said electrical signal when it contacts said conducting cover.

50. A foot contour sensing apparatus, comprising:

a base for holding an array of sensing pins biased against axial movement;

means for mounting the base so that the ends of the pins move toward and engage a surface of the foot;

means for counting predefined increments of movement as the base moves the ends of the pins into contact with the surface of the foot; and

means for storing the value of the count for each pin at the time the pin contacts the surface of the foot, the stored counts for the pins defining the sensed contour of the surface of the foot.

51. The contour sensing apparatus of Claim 50, wherein the base is disposed so that the force of gravity biases the pins against axial movement and the pins engage the top surface of the foot.

52. The contour sensing apparatus of Claim 50, wherein the base is disposed so that the ends of the pins face downwardly and press against the top surface of the foot, the pins being biased downwardly by resilient spring elements.

53. A foot contour sensing apparatus, comprising:

a base for holding an array of sensing pins biased against axial movement;

means for providing relative movement between said base and a surface of said foot so that the ends of the pins move toward and engage the surface;

means for measuring the relative movement of said base with respect to said surface as the pins engage the surface; and

means for storing a movement value for each pin indicative of the point at which the pin contacts the surface of the foot, the stored values for the pins defining the sensed contour of the foot.

54. A method for sensing the contour of a surface of the human foot, comprising the steps of:

providing a support for a plurality of sensing pins, each pin having a switch that generates an electrical pin actuation signal when the pin contacts a surface of the foot;

measuring the relative displacement between the support and the surface of the foot as the pins move against the surface of the foot; and

storing the value of the displacement measurement at the time that each pin generates said electrical pin actuation signal.

55. A method for sensing the contour of a surface of the human foot, comprising the steps of:

providing a support for a plurality of sensing pins, each pin having a switch that generates an electrical pin actuation signal when the pin contacts a surface of the foot;

counting fixed decrements in the distance between the support and the surface of the foot as the pins move toward the surface of the foot; and

storing the count that occurs at the time that each pin generates said electrical pin actuation signal.

56. A method for sensing the contour of a surface of an object, comprising the steps of:

providing a support for a plurality of sensing pins, each pin having a switch that generates an electrical pin actuation signal when the pin contacts a surface of the object;

generating an electrical count signal for each fixed decrement in the distance between the support and the surface of the object as the pins move toward the surface of the object;

multiplexing the pin actuation signals for input to a microcontroller;

applying said electrical count signals to the microcontroller; and

using the microcontroller to count the electrical count signals and store the count that occurs at the time that each pin generates its multiplexed pin actuation signal.

57. The method of Claim 56, wherein said step of using the microcontroller includes the steps of:

incrementing the count when each count signal is received;

checking the status of the multiplexed pin actuation signals for all sensing pins; and

storing the incremented count value for any pins that have active pin actuation signals.

58. The method of Claim 57, further including the step of storing a predefined maximum count for all pins that are not actuated.

59. The method of Claim 56, further including the step of providing a human foot as the object.

60. The method of Claim 59, further including the step of selecting shoes that are compatible with said stored counts.

61. The method of Claim 59, further including the steps of:

creating a database that includes information concerning the foot measurements and shoe purchases for a plurality of people;

determining from the database the shoe purchases of persons having foot measurements similar to the foot measurements detected for a particular person; and

selecting shoes for said particular person compatible with said shoe purchases of persons having similar foot measurements.

62. The method of Claim 59, further including the steps of:

creating a database that includes information concerning the foot measurements and shoe purchases for a plurality of people;

determining from the database the shoe purchases and foot measurements of a particular person; and

selecting shoes for said particular person compatible with the shoe purchases and foot measurements for that person.

63. The method of Claim 56, further including the step of sensing the contour of an interior surface of said object.

64. The method of Claim 56, further including the step of sensing the contour of an interior surface of a shoe.

65. A method for sensing the contour of an object, comprising the steps of:

providing a plurality of sensing pins;

moving the object and sensing pins toward each other;

detecting the relative displacement point at which each sensing pin contacts a surface of said object;

storing the detected relative displacement points for at least the sensing pins that contact said object; and

deriving information concerning a surface contour of the object from said stored relative displacement points.

66. A method for selecting shoes, comprising the steps of:

providing a plurality of sensing pins;

moving at least one human foot and the sensing pins toward each other;

detecting the relative displacement point at which each sensing pin contacts a surface of the at least one foot;

storing the detected relative displacement points for at least the sensing pins that contact said foot; and

deriving information concerning the size of said at least one foot from said stored relative displacement points.

67. The method of Claim 66, further including the step of selecting shoes compatible with the derived size of said at least one foot.

68. The method of Claim 66, further including the step of selecting shoes compatible with the derived sizes of a person's two feet.

69. The method of Claim 66, further including the steps of:

creating a database that includes information concerning the foot sizes and shoe purchases of a plurality of people;

determining from the database the shoe purchases of persons having foot sizes similar to the foot sizes derived for a particular person; and

selecting shoes for said particular person compatible with the shoe purchases of persons having similar foot sizes.

70. The method of Claim 66, further including the steps of:

creating a database that includes information concerning the foot sizes and shoe purchases of a plurality of people;

determining from the database the shoe purchases and foot sizes of a particular person; and

selecting shoes for said particular person compatible with the foot sizes and shoe purchases for that person.

71. The method of Claim 66, further including the step of sensing the contour of an interior surface of a shoe.

72. A method for selecting shoes, comprising the steps of:

obtaining the size of the feet of a plurality of people;

identifying the shoes purchased by said plurality of people;

creating a database that includes information concerning the foot sizes and shoe purchases for said plurality of people; and

selecting shoes for a particular person based at least in part upon the information of said database.

73. A method for sensing a surface contour of an object, comprising the steps of:

providing a plurality of sensing pins;

providing a switch for each pin arranged in a matrix of addressable rows and columns;

actuating the switch for each pin when the pin contacts a surface of said object;

matrix addressing said switches;

reading the actuation state of each switch;

detecting the relative displacement point at which each switch is actuated;

storing the relative displacement points for at least the sensing pins with actuated switches; and

deriving information concerning the contour of said surface from said stored relative displacement points.

74. The method of claim 73, further comprising the step of reading the actuation state of each switch when a predetermined voltage signal is applied to an addressable matrix line that includes the switch.

75. The method of claim 73, further comprising the steps of providing a diode for each switch and forward biasing each diode to read the actuation state of its switch when a predetermined voltage signal is applied to an addressable matrix line that includes the switch.